

WHAT IS CLAIMED IS:

1. An immersion lithography process, comprising:  
forming a photoresist layer on a material layer;  
forming a protective layer on the photoresist layer;  
5 performing an immersion exposure step to define an exposed portion and an unexposed portion in the photoresist layer;  
performing a solubilization step to solubilize the protective layer on the exposed portion of the photoresist layer; and  
performing a development step to remove the exposed portion of the photoresist  
10 layer and the protective layer thereon.
2. The immersion lithography process of claim 1, wherein acid is produced in the exposed portion of the photoresist layer in the immersion exposure step to alter the polarity of the exposed portion of the photoresist layer.
3. The immersion lithography process of claim 2, wherein the acid produced in  
15 the exposed portion of the photoresist layer diffuses to the overlying protective layer to alter the polarity of the protective layer on the exposed portion of the photoresist layer in the solubilization step.
4. The immersion lithography process of claim 3, wherein the exposed portion  
20 of the photoresist layer and the protective layer thereon are turned to be hydrophilic from a hydrophobic state with the immersion exposure step and the solubilization step.
5. The immersion lithography process of claim 1, wherein the solubilization step comprises a baking treatment.
6. The immersion lithography process of claim 1, further comprising forming an anti-reflection coating on the material layer before the photoresist layer is formed.

7. An immersion lithography process, comprising:
- forming a photoresist layer on a material layer;
  - forming an acid supplying layer on the photoresist layer;
  - forming a protective layer on the acid supplying layer;
  - 5 performing an immersion exposure step to define an exposed portion and an unexposed portion in the photoresist layer, while an acid is produced in the acid supplying layer;
  - performing a solubilization step to make the acid produced in the acid supplying layer diffuse to the protective layer and the unexposed portion of the photoresist layer;
  - 10 and
  - performing a development step to pattern the protective layer, the acid supplying layer and the photoresist layer simultaneously.
8. The immersion lithography process of claim 7, wherein the exposed portion of the photoresist layer and the protective layer thereon are turned to be hydrophilic
- 15 from a hydrophobic state with the immersion exposure step and the solubilization step.
9. The immersion lithography process of claim 7, wherein the solubilization step comprises a baking treatment.
10. The immersion lithography process of claim 7, further comprising forming an anti-reflection coating on the material layer before the photoresist layer is formed.
- 20 11. A mask layer structure applied in an immersion lithography process, comprising:
- a photoresist layer on a material layer; and

a protective layer on the photoresist layer for preventing mutual diffusion between the photoresist layer and an immersion liquid used in an immersion exposure step of the immersion lithography process.

12. The mask layer structure of claim 11, further comprising an acid supplying  
5 layer between the protective layer and the photoresist layer.

13. The mask layer structure of claim 11, further comprising an anti-reflection coating (ARC) under the photoresist layer.